AIR FORCE

QUALIFICATION TRAINING PACKAGE (AFQTP)

for

HVAC/REFRIGERATION

(3E1X1)

MODULE 22

AIR COMPRESSING EQUIPMENT

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REVIEW ANSWER KEY Key-1

Career Field Education and Training Plan (CFETP) references from 1 Apr 97 version.

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AIR FORCE QUALIFICATION TRAINING PACKAGES
for
HVAC/REFRIGERATION
(3E1X1)

INTRODUCTION

Before starting this AFQTP, refer to and read the "Trainee/Trainer Guide" located on the AFCESA Web site **http://www.afcesa.af.mil/**

AFQTPs are mandatory and must be completed to fulfill task knowledge requirements on core and diamond tasks for upgrade training. ***It is important for the trainer and trainee to understand*** that an AFQTP ***does not*** replace hands-on training, nor will completion of an AFQTP meet the requirement for core task certification. AFQTPs will be used in conjunction with applicable technical references and hands-on training.

AFQTPs and Certification and Testing (CerTest) must be used as minimum upgrade requirements for Diamond tasks.

MANDATORY minimum upgrade requirements:

Core task:
AFQTP completion
Hands-on certification

Diamond task:
AFQTP completion
CerTest completion (80% minimum to pass)

Note: *Trainees will receive hands-on certification training for Diamond Tasks when equipment becomes available either at home station or at a TDY location.*

Put this package to use. Subject matter experts, under the direction and guidance of HQ AFCESA/CEOT, revised this AFQTP. If you have any recommendations for improving this document, please contact the HVAC/R Career Field Manager at the address below.

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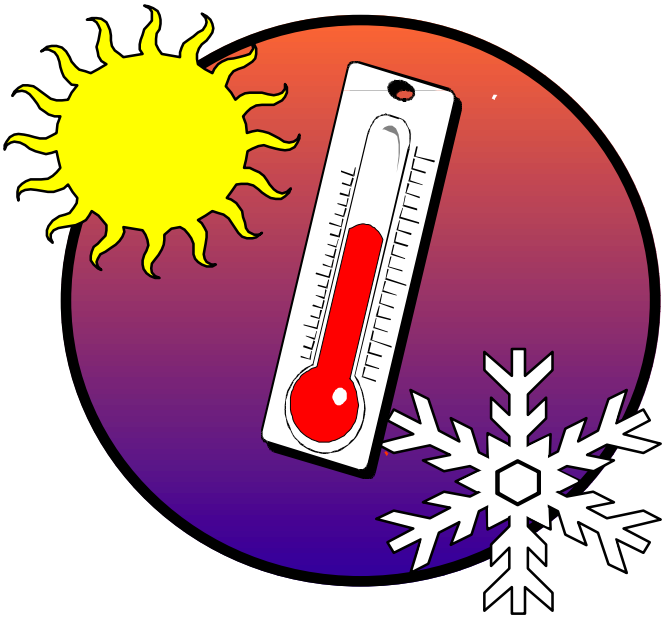


REPAIR

MODULE 22 AFQTP UNIT 6

TROUBLESHOOT (22.6.1.)

CORRECT MALFUNCTIONS (22.6.2.)

TROUBLESHOOT
CORRECT MALFUNCTIONS

Task Training Guide

STS Reference Number/Title:	22.6.1. Troubleshoot 22.6.2. Correct Malfunctions
Training References:	• TR: Trane Air Conditioning Manual, Manufacturer's Manual
Prerequisites:	• Possess as a minimum a, 3E131 AFSC.
Equipment/Tools Required:	• Personnel Protective Equipment. • Standard HVAC/R Tool Bag.
Learning Objective:	• Trainee should know the steps to safely troubleshoot and correct malfunctions in air compressing equipment.
Samples of Behavior:	• Trainee should be able to troubleshoot and correct malfunctions in air compressing equipment.
Notes:	
Any safety violation is an automatic failure.	

TROUBLESHOOT
CORRECT MALFUNCTIONS

Background: Air Compressors are used widely across the Air Force inventory to provide clean air for pneumatic control systems so that heating, ventilating, air conditioning, and refrigeration equipment can operate properly. In most cases a good recurring work program will prevent most malfunctions from happening, however there are times when the air compressor equipment will fail beyond the control of the craftsman. Therefore, it is important that you learn and practice sound troubleshooting skills that can return faulty equipment back on-line as quickly as possible. Troubleshooting is when you locate and eliminate sources of trouble(s), you must locate the original source of trouble. For example, when a motor overload trips, simply pushing the reset button is not considered locating the source or eliminating the source of the trouble. Something caused the motor current to rise and trip, or open the protective devices. An important note to remember is to eliminate the source of the problem, not just a symptom of the problem. This is commonly known as finding the root of the problem. Approach the troubleshooting process logically; look at the simple problems and work towards the complex ones. In this section we will provide some procedures for troubleshooting air compressors.

- **Air Compressing Equipment.** The automatic control must have some type of energy in order to operate. Pneumatic (air) controls are now being used as one of the prime movers of these controls. Air compressors produce the air used for these controls.

- **Air compressors.** There are two types of air compressors. One (referred to as industrial air) provides air for the pneumatic control system, enabling heating, ventilating, air-conditioning, and refrigeration (HVAC/R) equipment to operate. The other produces air for breathing. In both cases they have similar components. As you would expect, *the breathable air will need special filtering equipment.*
- **Compressor.** The reciprocating, rotary, screw, and centrifugal compressors are used. The principal machines for driving air compressors are electric motors, internal combustion engines, steam engines, turbines, and dual drives. Air compressors should be provided with no-load starting. Normally in the Air Force, electric motors are used. However, internal combustion engines are used when neither electricity nor steam is available. Steam is used for driving double-acting compressors, with the engine built as an integral part of the compressor. Because the demand for compressed air usually varies widely, the compressor is provided with a means of varying the volume of air compressed to maintain relatively constant pressure. Electric-motor-driven compressors and other compressors that operate at constant speeds should be equipped with multi-step capacity, automatic start-and-stop, or dual control. Internal combustion-engine-driven compressors should be provided with multi-step capacity control. The multi-step control system unloads or decreases the compressor capacity automatically in one or more steps while the compressor continues to operate at normal speed.

  The automatic start-and-stop system uses an automatic starter and pressure switch to start and stop the electric motor within definite limits of air pressure in the receiver. This control is recommended only when there is no demand for air during long periods and where very close pressure regulation is not required. A dual-control system is one that

provides manual switching to multi-step control, permitting continuous operation or automatic start-and-stop operation when the demand is intermittent.

- **Pressure regulators.** There are two kinds of controls recommended for use with air regulators: constant-speed and start-and-stop controls.

- **Constant-speed control.** We recommend this kind of control, which allows the unit to run continuously with the compressor unloading and loading in accordance with load requirements, where the demand for air is continuous throughout the operating period.

NOTE:
Periods that would require more than 10 starts per hour with start-stop control would use this control.

- **Start-and-stop control.** We recommend this second kind of control, which uses a pressure switch to open and close the motor circuit as the pressure in the air receiver reaches the required high or low limits, when the demand for air is intermittent or infrequent. The pressure range between start and stop should be wide enough so that the starting cycle cannot take place more than 10 times per hour. The pressure switch is normally set to cut in (close) at about 10 percent below the cutout pressure. It is desirable to have the compressor run for at least 10 minutes continuously per cycle. This will prevent excess moisture condensation in the crankcase. Dual control permits selection of either constant-speed control or automatic start-and-stop control and is recommended where the demand changes, as from day shift to night shift.

NOTE:
This control would be for a demand of fewer than 10 starts per hour.

- **Belts.** When first setting up a V-belt drive, check the alignment of the compressor and motor sheaves carefully. There should be a slight bow in the slack side of each belt when a properly adjusted drive is running. Do not pry belts on or off pulleys; use belt dressing or let oil or grease get on belts. Loosen and move the driver. All compressors should have guards to cover easily accessible moving or hot surfaces such as belts, pulleys, flywheels, and fans. These guards should be constructed of suitable mesh materials.

- **Intake air filter.** Every air compressor should have an intake filter to prevent dirt from causing unnecessary wear, sticking valves, scored cylinders, and accelerating carbonaceous buildup. The three basic types of filters are dry, viscous impingement, and oil bath filters. Dry filters usually consist of a felt cloth supported by wire forms and are excellent for many localities, particularly where dust storms occur. Normal vibration tends to shake off excessive dust, and it does not clog easily. Viscous impingement filters have woven or packed wire in cells or frames, and are coated with oil to hold dirt. These are not recommended for extremely dusty areas. Finally, oil baths remove dirt from air by scrubbing action. The dust is washed down and collects in a sump, from

which it is manually removed as necessary. These have good dust-removal capacity between cleanings. The choice among the three types will depend on locality and the type and quantity of dust involved. Filters should be protected from the weather by louvers or rain shields. Intake screens of 1/4-inch mesh should be provided to exclude foreign objects from the surface of the filters.

- **Air intake piping.** A clean, cool, dry air supply is essential to the satisfactory operation of an air compressor. Where possible, the compressor air intake should be piped to the outside air. It should terminate six feet or more above the ground, rise above building eaves, and extend several feet from the building. It should be located far enough from steam, gas, or oil engine exhaust pipes to ensure cool, clean, dry air that is free from dust, dirt, or moisture and free from contamination by exhaust gases. The open end of the intake pipe should be well hooded and screened to prevent rain, dirt, or dust from entering. Water in a compressor cylinder destroys lubrication, causes wear, and may damage valves. Pockets in the piping should have drain connections. The use of a commercial filter of the proper size for the compressor intake is recommended. The diameter of the intake pipe must be equal to or larger than the compressor air intake connection. If a long suction line is necessary, care must be taken to increase the pipe size to provide minimum pressure drop therein. All bends should be long-radius elbows.

- **Air discharge piping.** The discharge line between the compressor and the receiver, or after-cooler, should be the same size as the discharge opening of the compressor cylinder, or larger (if long) and should drain away from the cylinder. The discharge line should be as short as possible and short bends and fittings should be avoided. If a globe or gate valve is used in the discharge line between the compressor and receiver, a safety valve of sufficient size should be installed between this valve and the compressor to prevent any damage to the compressor, in the event the compressor is started with the valve closed. The safety valve should be capable of passing the full load capacity of the compressor and preventing the pressure from rising more than 10 percent above the maximum allowable working pressure. A trap and drain should be provided at the low points in the discharge line to permit draining periodically.

- **Intercoolers and Aftercoolers.** *Intercoolers* are used to remove heat from the air between stages or stage groups in multistage compressors and are usually an integral part of the compressor unit. Water is the usual cooling medium, but many small compressors have built-in, fin-type, air-cooled intercoolers. *Aftercoolers* are installed in the air discharge piping between the compressors and the receivers as near to the compressor as possible. The air is cooled in the aftercooler so that moisture in the air is condensed. A moisture separator at the outlet of the aftercooler removes the moisture and prevents it from entering the pipeline and receiver. Moisture in a compressed air system will wash away lubricants from air-operated tools, clog lines, decrease tool efficiency by freezing at the exhaust, cause corrosion, or cause water hammer. Aftercoolers maintain more uniform air temperature, thus reducing pipeline strains and resulting leaky joints created by continual expansion and contraction from varying amounts of un-cooled air flowing through the lines. Aftercoolers are shell-and-tube units in which the water circulates in the shell and air passes through the tubes.

In special cases, after-cooling and inter-cooling can be accomplished with atmospheric air using fin-surface radiators and fans. As we said, a moisture separator is required at the aftercooler outlet. Inter-coolers on multistage units will generally condense moisture from the air. This moisture must not be permitted to carry over to the next cylinder. Therefore, traps and drain valves from each separator section must be located to permit drainage. The amount of moisture condensed depends upon atmospheric conditions and the unit's size. When coolers are fitted with automatic traps, they should be so arranged that malfunctioning can be readily detected and proper steps can be taken to protect the machine.

- **Air receivers.** Air receivers are compressed air storage tanks and are an essential part of most compressed air systems. They absorb pulsations in the compressor discharge line, assure a steady flow of air to the service line, and store a reserve volume of compressed air for unusual momentary demands in excess of the capacity of the compressors. Receivers also aid in condensing moisture in the air discharged from the compressor, or moisture that is not removed in the aftercooler. The receiver is an unfired pressure vessel and should be built to the American Society of Mechanical Engineers (ASME) Code and properly stamped. Fittings should include a safety valve having sufficient capacity to handle the full output of the compressor, pressure gauge, and drain valve with the necessary piping. Set the air receiver on a secure foundation or pedestal off the ground. Make the piping connection to the compressor or aftercooler as short as possible and the discharge piping the same size as the compressor outlet or larger. Since the receiver aids in condensing moisture and oil from the air, it should be located in a cool location. Equip the receiver with a safety valve set to open at not less than 15 psig or 10 percent (whichever is greater) above the operating pressure rating of the compressor. However, the setting should never be higher than the maximum allowable working pressure stamped on the tank.

- **Safety devices.** Each water-cooled air compressor should have automatic excessive temperature devices to stop the compressor in case of an excessive temperature rise caused by failure of circulating water. Some air-cooled compressors have devices that will unload the compressor and sound an alarm and/or shut off the compressor when there is an abnormal increase in the temperature of the lubricating oil or if the lubricating oil pressure fails. Safety valves capable of manual operation should be provided on the air receiver between any line valve and the air compressor, and on intercoolers to relieve excessive pressure. If a safety valve blows during operation, stop the unit and determine the cause. Safety valves on the receiver will normally blow only if the pressure control is not functioning correctly. An intercooler safety valve will blow when there is valve breakage or leakage in the high-pressure stage. Any blowing safety valve indicates trouble somewhere that requires immediate action. Safety devices should be installed and so oriented that their discharge will not be a safety hazard to the operator during normal operation or periodic testing. Discharge lines should be sized so that the relieving capacity will not be reduced below that needed to protect the vessel.

- **Compressor location.** You will probably not have the responsibility for locating the compressor. However, it should be located in a clean, well-lighted position that is easily kept clean. Also, the location should leave enough room to permit inspection, cleaning, adjustment, and removal of parts, such as pistons and piston rods, belts, and sheaves. If the blueprint indicates that these requirements are not being followed, you should go to the engineer and get them changed.

- **Foundation.** Some small units can be fastened to a substantial floor. Large machines must have concrete foundations designed for both the static and dynamic forces. All reciprocating compressors generate both horizontal and vertical shaking forces. The large compressor foundations should be placed on firm solid footings, be big enough to absorb the unbalanced forces, and be insulated from the rest of the building to avoid vibration transmission.

- **Mechanical driers.** Pneumatic controls need to be moisture free. Moisture causes the lines and controls to malfunction. Use a mechanical drier to ensure a moisture-free control system. The mechanical air drier is basically a simple refrigeration system encased in a single housing. Usually, it is installed in the air line to the using source. It is rated at approximately 1600 Btu's per hour. It operates with up to 20 cubic feet per minute of compressed airflow through it. The moisture that is trapped is drained, usually through an automatic drain valve.

- **Breathable air.** This type of air needs to be oil free. It can be found in food handling, medical, and dental services. In these types of services, even the slightest presence of lubrication or carbon deposits will leave harmful and dangerous impurities in the air. To provide oil-free air, oil-less compressors are used. The reciprocating compressor requires no oil because it can use carbon or Teflon rings. These rings do periodically wear out and will need replacing. The centrifugal compressor can be used because oil is not needed because of its internal configuration. The rotary compressor can use water to help form a seal during its compression process. The cartridges that are outfitted for these systems purify the air by removing carbon dioxide, carbon monoxide, hydrocarbons, methane, halogenated solvents, and odors. For any application of air for human consumption, the system needs to be fitted with suitable in-line safety and alarm equipment. This additional equipment is necessary to properly filter and purify the air to meet the minimal standards outlined in the appropriate technical order.

- **Maintenance.** Various air compressors and compressor components require stipulated checks, testing, and related actions to be assured of proper operation. In this regard, we discuss air filters, safety devices, receiver tanks, daily inspections, and manufacturers' recommendations in some detail in this QTP.

- **Daily inspections.** Daily, or each operating shift inspections, include listening for unusual noise, cleaning the unit, checking for abnormal pressure, hot motors, hot bearings, and or hot stuffing boxes, and checking for proper unloader operation and automatic condensate drains. Drain the manual drain valves and check for leaks.

- **Air filter.** Air filters should be checked and cleaned weekly. However, these times may have to be shortened if excessively dirty or dusty conditions exist. You may have to extend the times if the air is exceptionally clean. Other weekly inspections include operation of all safety valves; belts for tension, wear, and deterioration; wiring for chafed or broken wires; and tubing for leaking connections.

- **Belts.** Belt sheaves must be in alignment to prevent excessive belt wear, noisy operation, and motor vibration. Use a straightedge to check alignment. Belts stretch slightly during the first few weeks of operation and must be adjusted periodically to ensure retention of the proper tension. Belts should be tight enough to avoid slippage, with consequent squealing and excessive belt wear, and to prevent the possibility of jumping from their pulleys. Belts that are too tight will cause overheating and excessive bearing wear and will overload the motor.

SAFETY:
ALWAYS PULL THE SWITCH AND APPLY A LOCKOUT OR DANGER TAGS WHEN ADJUSTING OR REPLACING BELTS, SO THAT THE MOTOR CANNOT START WHILE THE MECHANIC IS WORKING ON THE UNIT.

Usually, adjusting bolts are provided at the motor base to facilitate adjustment of the belt. Take up evenly on the adjusting bolts when moving the motor to avoid misalignment of the sheaves. Check for proper alignment before tightening the hold down bolts. When it is necessary to replace belts, the entire set must always be replaced. Do not use belt dressing on a V-type belt, because this will shorten its life. When removing belts, loosen the motor and move it toward the driven pulley. Forcing belts over the edge of the sheave stretches them excessively.

- **Safety devices.** Safety valves and other pressure relieving devices, such as rupture disks, are checked annually. Check to determine whether the valves and other pressure relief devices are in acceptable condition. Test the valves to ensure operation at the set pressure. Check to determine that the spring is correct for the service that the valve outlets and discharge headers are free from stoppage, and that the parts are not excessively worn or corroded.

- **Receiver tanks.** Inspect receiver tanks internally and externally at least once every two years for corrosion and other defects. The inspector must be a professional or operating engineer, or service mechanic, who is familiar with the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code and the causes of corrosion to know what details should be checked carefully. Also, the inspector must be able to complete the receiver wall thickness for the operating temperature and safety-valve setting; and must have at least five years experience in the design, construction, maintenance, and repair of unfired pressure vessels (including at least one year of inspecting vessels in service). Finally, this person should be designated specially by the Command Civil Engineer to perform these inspections. When qualified Air Force inspectors are not available, receivers may be inspected under contract by inspectors from an organization that holds a current commission from the National Board of Boiler and Pressure Vessels inspectors. Each receiver should have a permanent and progressive inspection record.

The record should have the vessel's serial number; location and metal thickness determined for critical points; computed allowable working pressure at time of next inspection; hydrostatic test pressure, if applicable; dates of inspections; and the date when next inspection is due. Also, the record includes the safety valve setting and the date that the safety valve was last inspected.

- **Hydrostatic test.** Hydrostatic tests are required at least once every three years for operating pressures above 200 psig when there is no means to thoroughly inspect the interior and exterior of the receivers. Hydrostatic tests are required also when the inspections and/or calculations indicate a condition that is questionable for the safety valve setting. Also, such tests must be conducted after a repair has been made to the vessel that could possibly affect its safety. These tests are not required for tanks having operating pressures of 200 psig or below or for vessels that can have a thorough visual inspection of the interior and exterior of the tank.

  The hydrostatic test, when required, consists of subjecting every joint in the vessel to a hydrostatic test pressure one and one-half times the maximum working pressure. Disconnect the compressor discharge line entering the receiver and lines leaving the vessel, drain the receiver, and remove the safety valves, gauges, and other appurtenances that should not be subjected to the test pressure. Use a calibrated test pressure gauge with a dial graduated for about twice the test pressure for this test. Provide vents at all high points of the receiver in the position of the test to ensure complete filling of the vessel with water with no air pockets forming while the vessel is filling. Increase the hydrostatic pressure gradually until one-half the working pressure is attained. Then increase the test pressure in steps of approximately 10 percent of the working pressure until one and one-half times the maximum working pressure is attained. Hold the pressure stationary at the maximum test pressure for a minimum of five minutes. After the maximum test pressure has been attained, visually inspect all joints and connections, doing this at a pressure not less than two thirds of the test pressure. Take all necessary safety measures, including the wearing of facemasks, during the testing under pressure.

- **Pneumatic test.** This type of test is more hazardous than a hydrostatic test; therefore, use it only when the vessels cannot be tested hydrostatically. It is required instead of a hydrostatic test when the vessel cannot be readily dried. The pneumatic test pressure will be one and one-fourth times the maximum working pressure. Disconnect the compressor discharge line entering the receiver and the lines leaving the vessel. If these lines are not to be used for supplying compressed air for the test, drain the receiver and remove the safety valve, gauges, and other appurtenances that should not be subjected to the test pressure. Use a calibrated test pressure gauge, one with a dial graduated for twice the test pressure. Increase the pressure gradually until a maximum of one-half the test pressure is attained. Then increase the test pressure in steps of approximately 10 percent of the test pressure until the required test pressure has been reached. Hold the pressure stationary at the maximum test pressure for a minimum of five minutes. After the maximum test pressure has been attained, inspect all joints and connections visually at a pressure equal to four-fifths of the test pressure. Take all necessary safety measures, including the wearing of facemasks during testing under pressure.

- **Manufacturer's manual.** *Oil changes and service of oil filters and strainers are performed according to the manufacturer's recommendations*. Also, perform the inspection and cleaning of suction and discharge valves according to the manufacturer's recommendations.

- **Crankcase.** The correct crankcase oil level should be maintained at all times. The time period between oil changes is that recommended by the manufacturer of the air compressor and modified as required by unusual conditions indicated by actual crankcase oil condition. The time period between oil changes will vary, depending upon the particular unit and its usage. There are definite differences in compressor units that prevent overall standards from being used. This time period has been noted to vary from 100 hours for a three- and four-stage, 3,000-psig, air-cooled compressor of one manufacturer to 2,000 hours for a double-acting, two-stage, 125-psig, water-cooled unit of another manufacturer. If you note that the oil is extremely dirty when it is drained or that there is water present, flush the crankcase with regular flushing oil. Do not use kerosene, gasoline, or flammable liquids. Avoid mixing different types or brands of oil, since there are some additives that are not compatible. Oil filters are usually of the full flow or cartridge type.

- **The cartridge filters may be the cleanable or throwaway type.** Replace the throwaway cartridges. Cleanable cartridges should be removed and cleaned with every oil change. Also, thoroughly drain and clean the filter housing of all sludge. Use a high grade of cylinder lubricating oil processed to minimize deposit formation as recommended by the compressor manufacturer. Follow the feed rate table recommendations provided in a given compressor manufacturer's manual. In starting a new unit or after a new piston or rings have been installed, ensure the rate of oil feed is heavy enough to produce a glazed surface. After this has been assured, the flow can be cut down gradually to a minimum feed rate. Periodically, as recommended by the manufacturer, examine the bore of the cylinder and the valves to ascertain that the minimum rate of feed is maintained. The cylinder wall should be covered with a thin film of oil, and the valves should be oily. Use only enough oil to furnish lubrication, since excessive quantities may result in rapid deposit on valves and other parts.

- **Unit cleaning.** Keep the entire unit free from dirt, oil, and grease. You do this for efficient operation and appearance. If necessary, blow dirt out of the cylinder fins and intercooler and aftercooler coils with compressed air, using low pressure, 35 to 45 psi, to avoid embedding hard dirt particles into the windings.

- **Filter element.** The intake air filter should be checked regularly to establish a regular maintenance schedule. If it is a cleanable filter, it should be cleaned in an Air Force approved cleaning solvent, dried, and then recharged with oil or whatever the manufacturer recommends.

- **Condensation.** As we said earlier, when air is compressed, its temperature and pressure increase. As the air is cooled under this higher pressure, the moisture condenses until the air is 100 percent saturated at that temperature and pressure. This condensation must be removed from the intercoolers, aftercoolers, receiver, and airline traps either manually or automatically. When manual drains are employed, you check them daily. Also, check automatic drains periodically to ensure they are working properly.

- **The 100-hour inspection.** This is an example inspection interval that applies to just one manufacturer. Do not use it for your inspections, but always refer, as required, to either the specific manufacturer's manual of your particular air compressor for its recommendations or to the applicable Air Force directives.

- **Air leakage check.** Check all piping and tubing threaded joints for air leaks, using soapy water. When checking the intercooler, aftercooler, and relief tubing, do so with the compressor running, since pressure is automatically relieved when the compressor stops. When you detect any leaks, tighten or replace the leaky fittings as necessary.

- **Vent tube valve check.** Check for a leaking seat by inserting the end of the vent tube in soapy water when the compressor is stopped. If bubbles appear, remove the valve for repair or replacement.

- **Tank valve check.** Check for leaks around the valve stem, using soapy water. If a leak is indicated, tighten the valve-packing nut, attaching nuts, and bolts. Check and tighten all bolts and nuts as required to maintain the proper torque recommended by the manufacturer.

- **The six-month inspection and service**. Lubricate the motor according to the manufacturer's manual or applicable Air Force directives. Check the pressure switch for loose screws and air leaks. Check the line starter and switch contact points for burned or pitted contacts and replace these if necessary. Maintain an operator's log for larger compressors that have pressures and temperatures of air, water, and oil annotated daily or for each operating shift. Any drastic change in the normal readings, as previously taken and recorded in the operator's log, indicates a condition that should be investigated. Proper corrective action generated from comments in the operator's log could prevent serious damage to the equipment. The daily and weekly inspections should be performed by the operating personnel, using the manufacturers checklist. This inspection is recorded in the operator's log. Also, all discrepancies recorded in the operator's log that concern the equipment is cleared at this time.

Table 1, Diagnostic for Air Compressor:

Problem	Possible Cause	Remedy
a. Air Compressor Off	1. No Power 2. Pressure Switch Open 3. Blown fuse 4. Tripped Overload Circuit breaker 5. Faulty Motor	1. Restore Power 2. Adjust/replace 3. Replace 4. Reset 5. Replace
b. Air Compressor Constantly Running.	1. Pressure Switch Closed 2. Air Leak 3. Safety relief valve opening 4. Loose Belts 5. Automatic Drain Valve Opening	1. Adjust/replace 2. Repair 3. Clean/Replace 4. Tighten/Replace 5. Repair/Replace
c. Low Air Pressure	1. Pressure Switch Open 2. Air Compressor Off 3. Air Leak 4. Faulty Compressor Valves	1. Adjust/replace 2. Restore Power 3. Repair 4. Repair/Replace Compressor
d. Low Air Volume	1. Tank full of water 2. Dirty Inlet Air Filter	1. Drain/Check Automatic Drain Valve. 2. Clean/Replace
e. Noisy/Vibration	1. Belts Loose/Miss-Aligned 2. Worn Compressor Bearings 3. Loose Compressor Mounts 4. Internal Compressor Problems 5. Belt Guard Not Secure	1. Adjust/re-align/Replace 2. Repair/Replace 3. Torque Compressor Mounts 4. Repair/Replace 5. Secure
f. Safety Relief Valve Opening	1. Pressure Switch Stuck Closed 2. Inoperative Relief Valve	1. Repair/Adjust/Replace 2. Repair/Replace
g. Excessive Condensation in Receiver	1. Automatic Drain Valve Stuck Closed	1. Repair/Replace
h. Motor Operates/No Air Pressure	1. Broken Belt 2. Pressure Relief Valve Open 3. Compressor Inoperative 4. Air Leak	1. Replace 2. Clean/Replace 3. Repair/Replace 4. Repair

NOTE:
When you are required to perform maintenance on air compressors, refer to the applicable manufacturer's manual or TO.

Review Questions
for
Troubleshoot
Correct Malfunctions

Question	Answer
1. Hydrostatic tests are required at least once every _____ years for operating pressures above 200 PSIG.	a. 2 b. 3 c. 4 d. 5
2. The pneumatic test pressure will be _____ times the maximum working pressure.	a. 1-1/4 b. 1-1/2 c. 2 d. 2-1/4
3. Inspect receiver tanks internally and externally at least once every _____ years for corrosion and other defects.	a. 2 b. 3 c. 4 d. 5
4. What are the 2 types of air compressors?	a. Industrial air b. Air for breathing with special filtering. c. Both a. & b. d. None of the above

TROUBLESHOOT

CORRECT MALFUNCTIONS

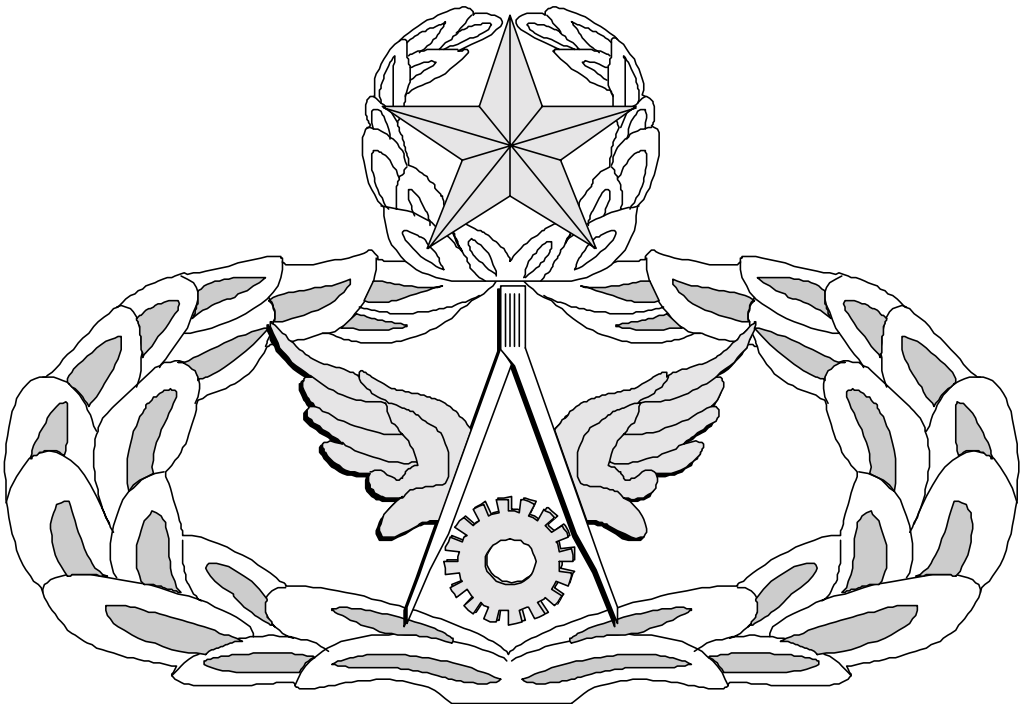
Performance Checklist		
Step	**Yes**	**No**
Operational Test		
1. Compressor Off		
a. Check Power		
b. Check Pressure Switch		
c. Check Safety Circuit		
2. Low Capacity		
a. Check Unloaders		
b. Check Tank		
c. Check Inlet Air Filter		
3. No Pressure		
a. Check Belts		
b. Check Compressor		
c. Check for Air Leakage		
d. Check Automatic Drain		

FEEDBACK: Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

Air Force Civil Engineer

QUALIFICATION TRAINING PACKAGE (QTP)

REVIEW ANSWER KEY



For

HVAC/REFRIGERATION

(3E1X1)

MODULE 22

AIR COMPRESSING EQUIPMENT

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

TROUBLESHOOT

(3E1X1-22.6.1.)

CORRECT MALFUNCTIONS

(3E1X1-22.6.2.)

Question	Answer
1. Hydrostatic tests are required at least once every _____ years for operating pressures above 200 PSIG.	b. 3
2. The pneumatic test pressure will be _____ times the maximum working pressure.	a. 1-1/4
3. Inspect receiver tanks internally and externally at least once every _____ years for corrosion and other defects.	a. 2
4. What are the 2 types of air compressors?	c. Both a. & b.